

WHAT IS CLAIMED IS:

1. A composition comprising a fusion protein comprising a functional displayed domain and a functional phycobiliprotein domain incorporated in a functional oligomeric phycobiliprotein, wherein the oligomeric phycobiliprotein provides a fluorescent tag.

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2. The composition of claim 1 wherein the phycobiliprotein domain is a natural phycobiliprotein domain.

10 3. The composition of claim 1 wherein the functional oligomeric phycobiliprotein is an α,β heterodimer.

4. The composition of claim 1 wherein the displayed domain comprises a moiety selected from the group consisting of an affinity tag, an oligomerization moiety, a specific binding moiety, and a signaling moiety.

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5. The composition of claim 1 further comprising a specific binding moiety selected from a streptavidin biotin-binding moiety, a biotinylated or biotinylatable moiety, and an antigen binding immunoglobulin moiety.

20 6. The composition of claim 1 further comprising a linker peptide between the displayed domain and the phycobiliprotein domain.

7. The composition of claim 1 further comprising a protease cleavage site between the displayed domain and the phycobiliprotein domain.

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8. The composition of claim 1 wherein the phycobiliprotein domain comprises at least one functionally attached bilin.

9. The composition of claim 1 wherein the displayed domain is refractive to expression in *E. coli*.

10. The composition of claim 1, wherein the displayed domain is substantially transparent to 5 wavelengths of visible light absorbed by phycobiliproteins.

11. The composition of claim 1, wherein the displayed domain is substantially transparent to wavelengths of energy emitted by the phycobiliprotein domain.

10 12. The composition of claim 1, further comprising a second fluorescent tag which provides intermolecular energy transfer with the phycobiliprotein.

13. The composition of claim 1, further comprising a second fluorescent tag which provides 15 intermolecular energy transfer with the phycobiliprotein, and the second tag comprises a cyanine dye.

14. A functional phycobilisome comprising the fusion protein of the composition of claim 1.

15. A method for making the fusion protein of the composition of claim 1, the method 20 comprising the steps of:

providing a nucleic acid encoding a polypeptide comprising a functional displayed domain and a functional phycobiliprotein domain;

making the polypeptide by expressing the nucleic acid in a cell or cell-free expression system; and

25 combining the polypeptide with a phycobiliprotein subunit under conditions to form the fusion protein.

16. A method for isolating a functional displayed domain, the method comprising the steps of: making the fusion protein according to the method of claim 15;

after the combining step, cleaving a peptide bond between the functional displayed domain and the functional phycobiliprotein domain; and separating the functional displayed domain from the functional phycobiliprotein domain.

- 5 17. The method of claim 15, wherein the making and combining steps occur in a cell.
18. The method of claim 15, wherein the making and combining steps occur in a cell, and the cell is or is a progeny of a cell which naturally expresses a phycobiliprotein.
- 10 19. The method of claim 15, wherein the making and combining steps occur in a cell, and the cell is or is a progeny of a cell which naturally expresses a phycobiliprotein, wherein the cell is a cyanobacterium.
- 15 20. The method of claim 15, wherein the making and combining steps occur in a cell, and the cell is or is a progeny of a cell which naturally expresses a phycobiliprotein, wherein the cell is a rhodophyte (red algae).
- 20 21. The method of claim 15, wherein the making and combining steps occur in a cell, and the cell is or is a progeny of a cell which naturally expresses a phycobiliprotein, wherein the cell is a cryptomonad.
22. The method of claim 15, wherein the making and combining steps occur in a cell, and the cell is or is a progeny of a cell which naturally expresses a phycobiliprotein, wherein the cell is an Anabaena cell.

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